

# Community Assessment of Drought Tolerant Maize for Africa (DTMA) in Kenya

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CIMMYT DTMA Project and KARI

The Drought Tolerant Maize for Africa (DTMA) Project is jointly being implemented by CIMMYT and the IITA, and is funded by the Bill & Melinda Gates Foundation and the Howard G. Buffet Foundation. The project is part of a broad partnership also involving national agricultural research and extension systems, seed companies, non-governmental organizations (NGOs), community-based organizations (CBOs), and advanced research institutes, known as the Drought Tolerant Maize for Africa (DTMA) Initiative. Its activities build on longer-term support by other donors, including the Swiss Agency for Development and Cooperation (SDC), the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Fund for Agricultural Development (IFAD), and the Eiselen Foundation. The project aims to develop and disseminate drought tolerant, high-yielding, locally-adapted maize varieties and to reach 30–40 million people in sub-Saharan Africa with these varieties in 10 years.

#### **About KARI**

Kenya Agricultural Research Institute (KARI) is the national agricultural research organization mandated to conduct agricultural, veterinary and policy research in Kenya and to make the products as widely accessible as possible to users. Development of seed systems capable of delivering improved germplasm to farmers, seed companies and other consumers is one of the strategic goals of KARI. This is pursued through active collaboration with Kenyan and international partners.

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## Executive Summary

While maize is the most important agricultural commodity in Kenya, its production often falls below requirements whenever there is drought. The main aim of the Drought Tolerant Maize for Africa (DTMA) project is to address such shortfalls in maize production through developing and disseminating drought tolerant cultivars.

The DTMA Project (<http://dtma.cimmyt.org>) is jointly being implemented by the International Maize and Wheat Improvement Center (CIMMYT) and the International Institute of Tropical Agriculture (IITA), and is funded by the Bill & Melinda Gates Foundation and the Howard G. Buffet Foundation. The project is part of a broad partnership also involving national agricultural research and extension systems, seed companies, non-governmental organizations (NGOs), community-based organizations (CBOs), and advanced research institutes, known as the Drought Tolerant Maize for Africa (DTMA) Initiative. Its activities build on longer-term support by other donors, including the Swiss Agency for Development and Cooperation (SDC), the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Fund for Agricultural Development (IFAD), and the Eiselen Foundation. The project aims to develop and disseminate drought tolerant, high-yielding, locally-adapted maize varieties and to reach 30-40 million people in sub-Saharan Africa with these varieties within 10 years.

Community surveys were undertaken for this project in Machakos and Makueni districts to provide baseline socio-economic information. Objectives of this survey were to: acquire information to facilitate the analysis of the socio-economic and bio-physical environment in which the DTMA varieties would be adopted and their performance evaluated; to provide the context for the design, conduct, analysis and interpretation of household surveys; and to integrate community level information with production and price data, and information from other sources, to facilitate the characterization of household livelihoods, cropping systems, farm produce and inputs markets, and to gain insights into the constraints faced and available opportunities.

The findings of the community survey portrayed two communities faced with shrinking land holding sizes and degradation of the natural resource base through loss of nutrients and erosion of soil, biodiversity and grazing resources. The communities face challenges including declining amounts of seasonal rainfall, increased frequencies of drought and increased risk of crop failure. While improvements in the road transport infrastructure were identified, along with improvement in the reach and densities of farm inputs distribution, the majority of smallholders have not benefited from this due to high access costs. Farm productivity in general, and maize productivity, in particular, are declining. This decline in productivity of maize was attributed to factors such as continued reliance on low-yielding and risk-prone varieties, lack of extension services and unavailability of credit. The general assessment was that more than two-thirds of households were food insecure most of the year. Despite marked improvements in the number and quality of service providers now available in the area, health status was considered to have deteriorated over the previous 10 years. The level of poverty (already higher than the national average) was considered to be increasing.

The findings of this survey indicate that attributes of DTM varieties such higher yields, better drought tolerance and shorter maturity periods relative to the currently marketed varieties currently in the market, are likely to lead to their more widespread adoption. The survey identified a fairly dense network of farm inputs suppliers which would facilitate seed distribution. Seed distribution is also likely to benefit from the network of non-governmental organizations (NGOs) and community-based organizations (CBOs) whose typical activity portfolios include aspects of agricultural development. Given the high levels of poverty in both Machakos and Makueni districts, widespread adoption of DTMA varieties is unlikely to occur in the absence of policies which address provision of incentives to farm inputs traders. Another reason for poor adoption is the difficulty that farmers face in accessing cash, as well as the aversion to risk of losing their investment in the maize crops in case of drought. The study identified a number of financial institutions and an existing cooperative movement in the two areas. At the time of the survey, lending for agricultural purposes was a low priority for these institutions. Another key finding was that adoption of DTMA varieties is likely to result in greater empowerment of women.

Although the qualitative methods employed for this study were strong, in interpreting the findings, conclusions and policy recommendations proposed by the authors, the reader should remember that limitations to the approach exist. Carefully designed adoption studies to facilitate statistical or econometric modeling of cause-effect relationships among household characteristics, variety attributes, institutional factors, drought risk and the likelihood of adoption must be implemented to complement the findings of this survey. Taken together, results of such surveys can greatly aid in establishing variety development objectives, evaluation or adaptation experiments and, most of all, in designing strategies to make the varieties available to the majority of farmers.

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## Acronyms and Abbreviations

ACIAR	Australian Centre for International Agricultural Research
AEZ	Agro-ecological zone
ALRMP	Arid Lands Resource Management Project.
AMREF	African Medical and Research Foundation
AMS	Africa Maize Stress
ASALS	Arid and Semi-Arid Lands
CBO	Community-based organization
CBS	Central Bureau of Statistics
CDF	Constituency Development Fund
CIMMYT	International Maize and Wheat Improvement Center
DAEO	District Agricultural Extension Officer
DAO	District Agricultural Officer
DCO	District Cooperatives Officer
DDO	District Development Officer
DLC1	Dryland Composite 1
DM	Dry mid-altitude
DMOH	District Medical Officer of Health
DT	Dry transitional
DTMA	Drought Tolerant Maize for Africa
FGD(s)	Focal Group Discussion(s)
GDP	Gross Domestic Product
GoK	Government of Kenya
GPS	Global Positioning System
GDP	Gross Domestic Product
ICRISAT	International Crops Research Institute for Semi-Arid Tropics
IDA	International Development Association
IFAD	International Fund for Agricultural Development
IL	Inner lowlands
KAPP	Kenya Agricultural Productivity Project
KARI - AMS	Kenya Agricultural Research Institute – Africa Maize Stress project
KCB	Katumani Composite B.
KI	Key informant
KNHDR	Kenya National Human Development Report
K-REP	Kenya Rural Enterprise Programme
KShs	Kenya Shillings
LATF	Local Authorities Transfer Fund
LH	Lower highlands
LM	Lower midlands
LR	Long rains
masl	Meters above sea level
MoE	Ministry of Education
MTEF	Medium Term Expenditure Framework
NALEP	National Agricultural and Livestock Extension Project
NGOs	Non-governmental organizations
SIDA	Swedish International Development Agency
SR	Short rains
UM	Upper midlands

# 1. Introduction

Kenya has a population of 28,241,000 (GoK 2007a.) and a land surface area of 582,646 km<sup>2</sup>. The country has five main agro-ecological regions: a narrow, humid to sub-humid coastal strip; bush-covered plains in the interior; high-lying scrublands in the northwest; fertile grasslands and highland forests in the south-west; and the Great Rift Valley in the west, where some of the country's highest mountains, including Mount Kenya (5,199 m) are situated, as well as Lake Turkana. Except for the temperate highlands, the climate is hot and dry. Coffee, tea, petroleum products, cereals, and fresh vegetables, fruits, and flowers are the chief exports. Large numbers of cattle are pastured in the grasslands. Industry, which is expanding, includes oil refining, food processing, and the manufacture of consumer goods, cement, and textiles. Agriculture, dominated by smallholder farming, directly contributes 26–27% of Kenya's gross domestic product (GDP). The range of agricultural commodities includes cereals and pulse crops, horticulture and floriculture, roots and tuber crops, industrial crops, dairy production and ranching (Jaetzold and Schmidt 1983). The staple commodities are maize and sorghum (cereals), beans, cowpeas and pigeon peas (pulses), potatoes and cassava, meat, milk and an assortment of fruits and vegetables. The main tenets of the agricultural policy are food security, income generation, employment creation and poverty alleviation. While maize is the most important agricultural commodity, production often falls below requirements due to drought, necessitating massive imports.

This study is part of the efforts of the Drought Tolerant Maize for Africa (DTMA) project. The project is jointly being implemented by CIMMYT and the IITA, and is funded by the Bill & Melinda Gates Foundation and the Howard G. Buffet Foundation. The project is part of a broad partnership also involving national agricultural research and extension systems like the Kenya Agricultural Research Institute (KARI), seed companies, non-governmental organizations (NGOs), community-based organizations (CBOs), and advanced research institutes, known as the Drought Tolerant Maize for Africa (DTMA) Initiative. Its activities build on longer-term support by other donors, including the Swiss Agency for Development and Cooperation (SDC), the German Federal Ministry for Economic Cooperation and Development (BMZ), the International Fund for Agricultural Development (IFAD), and the Eiselen Foundation.

The DTMA project builds on previous successes and on-going research, and boosts the development of new maize varieties with dramatically improved drought tolerance. The vision of the project by its tenth year (2016) is as follows:

- to generate maize with 1 ton per ha yield increase under drought stress conditions
- to increase average productivity of maize under smallholder farmer conditions by 20–30% on adopting farms, and
- to reach 30–40 million people in sub-Saharan Africa (SSA), adding an annual average US\$ 160–200 million of grain in drought-affected areas.

This project proposes to reach a greater number of poor farmers in SSA with open-pollinated varieties (OPVs) and hybrids that have higher drought tolerance thus reducing farmers' vulnerability, increasing their food security and improving their livelihoods in drought years.

## The community survey

The community surveys developed in Kenya for this project were undertaken in the Machakos and Makeni districts. Qualitative and quantitative information at district and community level was collected to characterize the maize production systems facing drought risk. The information captured:

- Drought risk experiences, and perceptions and attitudes,
- Livelihoods diversity and strategies for coping with drought and related institutional factors,
- Adoption, non-adoption, and dis-adoption of improved maize varieties since 1997,
- Farmer evaluation of traditional and improved maize varieties in relation to drought (e.g. yield increments; food security: reduction in hunger months; cash income; etc.), and
- Maize production constraints, including improved maize seed suppliers operating in the area.

## Objectives of the community survey

The study was guided by three main objectives:

- Acquiring information (not obtainable through household surveys at reasonable cost) to facilitate a qualitative analysis of the socio-economic and bio-physical environment in which the DTMA varieties are likely to be adopted.
- Providing the context for design, conduct, analysis and interpretation of household survey results and a basis for triangulating the community level information with data from the planned household survey.
- Integrating community level information with production and price data, and information from other sources to facilitate characterization of household livelihoods, cropping systems, farm produce and inputs markets, and to gain valuable insights into constraints faced and available opportunities.

### 1.1 Data collection procedure

Community focal group discussions (FGDs), key informant interviews (KI) and a variety of secondary sources uncovered detailed information about the agricultural production systems within Machakos and Makueni districts where maize is the main food and cash crop. The community survey also yielded information for use in characterizing drought risk, a significant feature of farming in the two districts. The areas of focus of the DTMA survey were Kangundo Division in Machakos District and Kaiti Division in Makueni District.<sup>1</sup>

Kangundo and Kaiti divisions where the community surveys took place now fall within the newly established Kangundo and Makueni Districts respectively. Since the new districts have yet to establish key administrative, institutional and functional structures of their own, district-level insights from key informants and secondary sources reported in this document refer to Machakos and Makueni districts before they were sub-divided, unless otherwise stated. Table 1 shows the study sites, their global positioning system (GPS) coordinates and the number and gender of participants.

**Table 1. Sites where focal group discussions were held.**

Site	Geo-reference of locations			No of participants at FGDs		
	South	East	Alt (masl)	Male	Female	All
<b>Machakos District</b>						
Kangundo	1.14750	37.13333	1650	6	2	8
Kikambuani	1.25761	37.19528	1601	10	2	12
Kawethei	1.34935	37.32215	1505	5	4	9
Ngangani	1.35388	37.37991	1481	9	3	12
Kakuyuni	1.36655	37.34390	1507	9	5	14
<b>Makueni District</b>						
Kaumoni	1.14222	37.24556	1206	10	5	15
Kilala	1.18722	37.13889	1189	7	5	12
Mavia meu	1.34414	37.14667	1564	11	6	15
Ukia	1.36944	37.16278	1236	5	3	8
Iuani	1.73391	37.53410	1546	8	7	15
Mukuyuni	1.74797	37.46299	1348	8	4	12
Kyuasini	1.78766	37.47393	1315	11	1	12

A total of 12 focal group discussion (FGD) sessions were conducted—five in Machakos District and seven in Makueni District, as shown in Table 1. The sites were selected so as to capture the range of agro-ecological variation that is experienced at the community level. In both districts, participation was drawn from farmers, farm input suppliers, extension service providers, students and community leaders. A fair representation by gender of participant was achieved (30% and 35% of participants in Machakos and Makueni, respectively, were women). Checklists were used to guide discussions at the FGD and KI interviews. Both exercises took place between June and August 2007.

<sup>1</sup> During the year this survey was conducted (2007), Machakos District was sub-divided into three new districts (Kangundo, Yatta and Machakos districts). In the same year, Makueni District was sub-divided into two new districts (Makueni and Kibwezi Districts).



Figure 1. FGD sessions in progress (Kaumoni and Kilala, Makueni District).

## 2. Synthesis of information with focus on drought and (drought-tolerant) maize

It is widely believed that much of the farm land in Machakos and Makueni districts is prone to frequent droughts (Tiffen et al. 1994). Government statistics (e.g., GoK 2005) indicate that during periods of drought, shortfalls in maize production occur. As maize is the main staple in the region, a sizeable proportion of farm households encounter severe hardships as they strive to meet their food requirements following drought episodes. In attempting to provide a sustainable solution to this problem, 78 maize varieties have been released between 1964 and 2004. Most of these varieties were developed by the Kenya Agricultural Research Institute (KARI) and more recently, universities, and private and public sector seed companies. Out of these 78 varieties, about 20 were bred for the growing conditions found in the dry mid-altitude (DM) and dry transitional (DT) agro-ecological zones. A drought resistant variety, Katumani Composite B (KCB) was released in 1968, and this was followed by release of Dryland Composite 1 (DLC1) in 1989. A number of other varieties have been developed since, mostly, by the CIMMYT/KARI Africa Maize Stress (AMS) project. To complement the plant breeders' effort, KARI has developed farmer recommendations for fertilizer use, weed management, and pest and disease control for these varieties. While the Kenyan farmer in wetter areas has benefited from significant yield improvement, households in drought-prone areas have not. The DTMA project intends to develop varieties which should perform well even under drought conditions.

## 3. General information at the district level

### Machakos District

Machakos District stretches from latitudes 0°45'S to 1°31'S and from longitudes 36°45'E and 37°45'E; its total area was 6,281 km<sup>2</sup> with a population of 906,644 persons according to the 1999 Population and Housing Census (GoK 2007a). The district has a high population growth rate since it is preferred by large families, and has high urbanization rates in Machakos, Athi River, Tala-Kangundo, Matuu, and Masii towns. There is an increased rate of settlement in areas of marginal agricultural potential (GoK 2002a; GoK 2007a), and this trend is widely reported to have characterized the pattern of settlement in the two districts for more than a century (O'Leary 1975; Tiffen et al. 1994).

### Makueni District

Makueni District stretches from latitude 1°35'S to 3°01'S and from longitude 37°10'E to 38°30'E. The district had a total area of 7,965.8 km<sup>2</sup>, out of which 474.1 km<sup>2</sup> and 724.3 km<sup>2</sup> formed the fabulous Tsavo West National Park and Chyulu Hills Game Reserve, respectively. The district had 771,545 persons according to the 1999 Population and Housing Census (GoK 2007a). There are several upcoming market centers such as Wote,

Kathonzweni, Matiliku, Kibwezi, Mtito Andei, Makindu and Mukuyuni, which offer investment and employment opportunities for the residents of the district (GoK 2002b). While the highest concentration of the population is in the hilly areas, excess numbers are extending the settlement margin further into land of low to very low agricultural potential. By 2001, there were 30,000 declared squatters in the district (GoK 2002b).

### **3.1 Administrative and social features**

Administratively, Kenya is divided into eight provinces (Nairobi, Central, Eastern, Coast, Rift Valley, Nyanza, Western and North Eastern) for the purpose of co-ordination of government functions. Each province is divided into several districts, and each district is further divided into one or more administrative divisions. Within this hierarchy, one or more locations may comprise a division. Each location is further divided into one or more sub-locations. At the base of this pyramid is the village, also referred to as area or sub-unit. Operationally, the hierarchy is managed by the Provincial Administration, the field arm of the Office of the President. Machakos and Makueni districts fall within Eastern Province. While the two districts are populated predominantly by the Kamba community, some of the other 41 communities which make up Kenya's population, notably, the Kikuyu and Luo, are represented in varying degrees.

Machakos District was divided into 12 divisions, 62 locations and 225 sub-locations. The district had six parliamentary constituencies and five local authorities with a total of 51 electoral wards. Each constituency was represented by a Member of Parliament. At the time of the study, the district had 186,297 households averaging 4.9 persons. Makueni District had 17 administrative divisions, 63 locations and 187 sub-locations. The district had five parliamentary constituencies and 69 electoral wards for local authorities. There were 144,320 households, averaging six persons.

### **3.2 Physical features**

The centre of Machakos and the north of Makueni mainly consist of hills and small plateaus rising between 1,800–2,100 meters above sea level (masl). Machakos District is surrounded by a large plateau that rises to about 1,700 masl in the west and slopes to 700 masl in the south east. The mean elevation is, however, 1,357 masl in Machakos and 1,047 masl in Makueni. This undulating plain is broken by isolated mountains in the north-west, the volcanic out-flow of the Yatta Plateau in the east and Chyulu Hills in the south-east. Figure 2 shows the typical layout of the landscape. Total annual precipitation ranges from 500–1,300 mm/year, or 100–450 mm/short rainy seasons and 80–530 mm/long rainy season.

The major land formations in Makueni District include the volcanic Chyulu Hills in the south and in the north, Mbooni and Kilungu Hills which rise to 1,900 masl. Apart from the Chyulu Hills, the south of the district is largely a low-lying grassland (averaging 600 masl) which receives little rain but has potential for ranching. Athi River (and its tributaries, i.e., Kambu, Kiboko and Mtito Andei) form the major drainage system for the two districts.



**Figure 2. Typical terrain in the Kenyan dry transitional zone**

Aspects of elevation and precipitation for both Makueni and Machakos districts are highlighted in Table 2.

**Table 2. Elevation and rainfall statistics**

District	Machakos		Makueni	
	Mean	Range	Mean	Range
Elevation	1357.42	856 – 2134	1046.9	444 – 2174
Mean rainfall (mm/year)	772.93	510 – 1160	705.49	543 – 1006
Short rains (mm/season)	350.16	178 – 464	333.87	215 – 443
Long rains (mm/season)	338.58	246 – 544	279.15	189 – 424

*Source: Jones (1988) database cited in Corbett (1998).*

### 3.3 Agro-ecological information

Rainfall distribution in the two districts occurs in two seasons—the short rainy season which typically begins during October/November and ends during January/February; and, the long rainy season which begins in March and ends during August/September (see Table 2 for annual precipitation). Other agro-ecological data are presented in Tables 3 and 4. The mean monthly temperature varies between 18°C–25°C, with the hottest months being February and October, and the coolest being July (Jaetzold et al. 2006; GoK 2005).

**Table 3. Agro-ecological zones (Machakos District).**

Agro-ecological zone <sup>a</sup>				Major enterprises
Zone	Area (%)	Area km <sup>2</sup>	Annual rainfall mm	
AEZ II	3	186	1000	Maize, coffee, dairy, beans
EZ III	9	557	800-850	Maize, coffee, dairy, beans, p. peas
AEZ IV	40	2474	700-750	Maize, cotton, livestock, beans, pigeon peas, cowpeas, mangoes
AEZ V	31	1917	600-650	Sorghum, cotton, livestock, sunflower, pigeon peas, cowpeas, bee keeping, mangoes
AEZ VII	17	1051	<600	Ranching

Source: GoK 2005; <sup>a</sup>AEZs II and III (Jaetzold et al. 2006; GoK 2005) correspond to the maize dry transitional zone described by Hassan (1998).

**Table 4. Agro-ecological zones (Makueni District).**

AEZ	Administrative Divisions	Description/major enterprise
LH2	Kilome, Kilungu, Mbooni, Chyulu	Maize, dairy and potato Annual mean temperature: 16.0-17.9°C
UM3	Kilome, Kilungu, Mbitini, Mbooni, Chyulu	Marginal coffee zone Annual mean temperature: 17.9-20.5°C
UM4	Kilome, Kilungu, Mbooni, Kaiti	Sunflower, maize Annual mean temperature: 17.9-20.9°C
LM3	Kee and Kaiti	Cotton Annual mean temperature: 20.9-22.0°C
LM4	Wote Tulimani, Kisau, Kasikeu, Mbitini and Matiliku	Marginal cotton. Annual mean temperature: 20.9-22.0°C
LM5	Kibwezi, Mtito Andei, Nguu, Kathonzweni, Kalawa, Makindu	Livestock, millet. Annual mean temperature: 21.6-24.0°C
LM6	Makindu and Nguu	Lower midland Ranching zone
IL6	Mtito Andei and Kibwezi	Inner lowland zone

Note: LH – lower highlands; LM – lower midlands; UM – upper midlands; IL – inner lowlands.

Source: GoK 2006

### 3.4 Government projects in the area

All parliamentary constituencies in Kenya benefit from the Constituency Development Fund (CDF) as well as the Local Authorities Transfer Fund (LATF). Projects under the CDF and LATF are decided upon at the constituency level with participation of stakeholders. Some of these projects have elements of agriculture. Overall, 81 government sponsored projects (including CDF and LATF) were implemented in Machakos District. The major projects spearheading development in the district were water (12), public works (10), health (13) and agriculture (8). Over the 2002–2008 plan period, the agricultural sector alone had eight projects for implementation in the district. In the new Kangundo District, CDF and LATF facilities were mainly used in development and maintenance of transport infrastructure. Nearly all divisions had the National Agricultural and Livestock Extension Project (NALEP) activities.

According to district level sector leaders contacted as key informants—the District Medical Officer of Health, the District Agricultural Officer, the Manager of the National Cereals and Produce Board depot at Makueni, the District Development Officer and the District Cooperatives Officer (DSDO)—Makueni District also benefits from the CDF and NALEP government initiatives. The Arid Lands Resource Management Project (ALRMP<sup>2</sup>), whose activities include seed bulking, irrigation and environmental conservation, is active in the whole district. The Kenya Agricultural Productivity Project (KAPP), funded by the International Development Association

<sup>2</sup> This project operates in 10 districts which have arid zones in four provinces in Kenya. The project falls under purview of the Minister in charge of special projects in the Office of the President.

(IDA) promotes private extension service providers and farm improvement opportunities for smallholders. The KAPP Coordinator indicated that the project is only active in Kathonzweni, Kalawa, Kasikeu and Kee divisions. The International Fund for Agricultural Development (IFAD) also supports the Eastern Province Horticultural and Traditional Foods Crops Project. Dubbed “*Njaa Marufuku*”, the initiative is operational district-wide and is largely concerned with group mobilization. The National Cereals and Produce Board (NCPB) is involved in cereal storage and marketing; with a role in farm input distribution. NALEP has activities in all divisions in Makueni District.

### 3.5. Projects initiated by community based organizations (CBOs) and non-governmental organizations (NGOs)

According to information obtained from the Machakos DSDO, the entire district had a total of 11,815 groups registered between 2002 and 2005. Out of these, 1,348 were in Kangundo Division. The majority of these groups were organized around the self-help concept. In Makueni District, a cumulative 14,103 groups had been registered between 1992 and 2006. Among these, 4,045 were women groups.

**Table 5. Numbers of community-based organizations (Machakos District).**

Administrative Area/Division	Self Help Groups	Women Groups	Youth Groups	Total
Kangundo	879	368	101	1348
Matungulu	372	273	75	720
Machakos District	7678	3708	852	11815

Source: Data from the Department of Social Services, Machakos, August 2007

The Makueni DSDO indicated that only about 1,000 groups were active. It was learnt from the DSDO that groups are formed for particular purposes and dissolve after the original objective behind establishment of the group has been met. Given that the year 2007 was an election year, the DSDO anticipated a surge in the number of applications for group registration.

**Table 6. Numbers of community-based organizations (Makueni District).**

Type of organization	Kaiti Division <sup>a</sup>	Makueni District
Undetermined	15	348
Women Groups	3	4,045
Youth Groups	32	1,984
Self-help Groups	13	7,726
Total	63	14,103

Note: <sup>a</sup> According to DSDO only 2000 groups were active. About 181 were registered in Makueni District.

Source: Data from the Department of Social Services, Machakos, August 2007

#### 3.5.1 NGOs and other volunteer organization-initiated projects

There were nine NGOs in Machakos and 11 in Makueni. Promotion of Rural Initiatives and Development Enterprises (PRIDE), Kenya Rural Enterprise Program (K-REP), Christian Children’s Fund (CCF), World Vision and Maendeleo ya Wanawake were active in both districts. Most of the NGOs (70%) active in the two districts were international; mainly involved in capacity-building and conducting field demonstrations on agricultural or farming techniques (e.g., German Agro-Action) in areas of their specialization. The functions of most of these NGOs were broadly similar. Nearly all undertook activities related to building capacities of members of households for participation in development initiatives within the communities they served. Agriculture based NGOs (e.g., German Agro-Action) were also involved in relief seed distribution and demonstration of better farming techniques. The most active NGOs in the two districts are listed in Table 7.

**Table 7. Non-governmental organizations based in Machakos and Makueni Districts.**

<b>District</b>	<b>Name of NGO</b>
Machakos	Promotion of Rural Initiatives and Development Enterprises (PRIDE)
	Kenya Rural Enterprise Program (K-REP)
	Kenya Red Cross Society
	Christian Children's Fund (CCF)
	World Vision Kenya
	Undugu Society of Kenya
	World Neighbors
	Institute of Cultural Affairs
	Maendeleo ya Wanawake
Makueni	African Medical Research Foundation (AMREF)
	Promotion of Rural Initiatives and Development Enterprises (PRIDE)
	Act Now
	German Agro-Action
	Plan International Kenya
	Care International Kenya
	Kenya Rural Enterprise Program (K-REP)
	Kenya Red Cross Society
	Christian Children's Fund (CCF)
	World Vision Kenya
Maendeleo ya Wanawake <sup>3</sup>	

Source: GoK (2002a, b)

### 3.6 Unions, associations, and cooperatives

#### Machakos District

In 2006, total membership in the various types of cooperative societies in Machakos District stood at 100,839 persons. With a share capital of KShs 1.4 billion (about US\$ 20 million), the contribution of societies and unions in the economy of the district is indisputable. Naikoni Kumini (horticulture), Kambuthu Farmers Cooperative Society Ltd (coffee) and Wamunyu Farmers Cooperative Society Ltd (dairy marketing) are some of the cooperative societies that were affiliated to the giant Machakos District Cooperative Union. Savings and credit cooperative societies (SACCOs), however, had the largest share of membership. The number of SACCOs was rising while that of coffee-based societies was declining, perhaps because of rising costs of production coupled with unstable prices within the coffee industry. Many societies and unions exhibited low levels of activity but the Ministry of Cooperative Development was making efforts to eliminate the major constraints to increased productivity of the cooperative movement.

#### Makueni District

There were 20 cooperatives in Makueni District, distributed as follows: seven dairy; three coffee; one bee-keeping; seven horticulture; one multi-purpose and one SACCO. Cooperative societies tended to focus on the main income-generating activities in the district, such as dairy, coffee and horticulture. Development of the maize enterprise did not appear to be benefiting much from the cooperative movement. There were, however, a few cases in which fertilizer and maize seed were offered to cooperative society members as in-kind credit. The Swedish Cooperative Centre (dealing with capacity-building and market linkage in dairy, cereals, and horticulture and cotton sectors) was the one of the most important cooperative unions in Makueni District.

<sup>3</sup> An umbrella women organization formed after independence to coordinate their development activities in Kenya.

## **4. General information on main changes in the community**

Some indicators of the quality of life and welfare indicators were considered in depth at the FGDs. Between 1997 and 2006, the cost of farm inputs rose despite falling prices for farm produce and reduced access to output markets, resulting in lower household income. At the household level, health problems have increased despite increased numbers of health facilities. Although the number (and quality) of health service providers has risen over the years, only the well-off who have the means to pay for these services have benefited. High levels of poverty in the area have effectively put these services out of reach for the majority of households. Over the same period, the frequency, incidence and severity of droughts increased, resulting in further poverty in the community. Machakos had 59% of residents generally classified as poor, while Makueni District had poverty rate of 73.5%, with the overall poverty level for the same year being 58.6%. Migration to towns in search of employment or business and trade opportunities had increased.

### **4.1 Health status and services**

Distribution of health facilities in Eastern Province in which Machakos and Makueni fall, rose from 308 in 1990 to 804 in 1999. The bed-and-cot capacity in the hospitals rose by 41%, from 4,769 to 6,736 (Mwabu et al. 2002). While the assessments at the FGDs were that the state of health is not improving, key informants and secondary sources indicated that the two districts have a fairly dense network of health facilities. In 2006, Machakos District had 274 facilities and out of these, 53 were in Kangundo Division. Most of these facilities were provided and operated by private investors or religious organizations. Public sector facilities typically offer services at a lower cost especially in the sparsely populated but impoverished remote areas. However, according to the District Medical Officers of Health (DMOH) of Machakos and Makueni, constraints on their budgets have led to some of the facilities in the outlying areas not being operational. Focal group discussions (60%) revealed that access to quality health care services has declined despite increased numbers of such facilities. This view is consistent with the Kenya National Human Development Report (KNHDR 2006) which states that many people had poor access to qualified doctors in Machakos (81%) and Makueni (55%).

The FGDs expressed satisfaction with the state of nutrition, except child nutrition in both districts—the proportion of underweight children below 5 years was 24% in Machakos and 16.9% in Makueni. The proportion of people expected to survive beyond age 40 was marginally higher (34% in Machakos and also 34% in Makueni) than that of Kenya (33%) (KNHDR 2006).

In the 10 health facilities where 1,166 people were tested for HIV/AIDS, prevalence was higher for females (13%) than for their male counterparts (6%). Mwabu et al. (2002) estimated the prevalence rates for Makueni and Machakos for 2000 at 12.4% in each of the districts.

### **4.2 Access to input and output markets**

In Makueni, the major market centers are Wote, Kathonzweni, Mukuyuni, Kola, Nunguni, Emali, Kambu, Mito Andei, Makindu, Kalawa and Tawa. In Machakos, some of the major market centers are Machakos, Athi River, Tala-Kangundo, Masii, Mwala and Matuu. Both districts have a fairly well-distributed network of farm inputs suppliers. There were 75 farm input distribution points spread among 15 market centers in Makueni District, serving 144,320 households. Farm produce marketing is generally undertaken by individual smallholders, either at the farm gate or at the nearest market centre. Most of the FGDs indicated that the farm inputs had become more accessible but were expensive. In a few cases, long distances to the input markets (upto 68 km in Machakos and 117 km in Makueni) were reported. Not surprisingly, however, the FGDs were more concerned about high prices than the distances to supply points as constraints to farm input acquisition. As noted by O'Leary (1975), for instance, members of the Machakos and Makueni communities have a long tradition as long distance travelers in the East Africa region.

### 4.3 Education

Low levels of investment in human capital development are widely considered to be a major impediment to economic growth and eradication of poverty in sub-Saharan Africa (Kabubo-Mariara 2007). Placed at 62% in Makueni and 64% in Machakos, compared to 69% in Kenya, the two districts appear to have low literacy levels (KNHDR 2006). Taking primary school enrolment as an indicator of community access to education, both districts had rising trends in enrolment between 1997 and 2005. In Machakos, enrolment rose from 223,366 to 273,593 pupils while that of Makueni rose from 203,127 to 255,275 pupils during the same period (GoK 2006, MoE unpublished data). Following the introduction of free primary education in the country in 2003, about 1.5 million children joined primary school nationally. However, there were still many children of school-going age who were out of school. The gross enrolment rate for 2003 was 104% while the net enrolment was estimated at 77% (Vos et al. 2004). In a recent analysis, Kabubo-Mariara (2007) identified several factors influencing school enrolment: boys are more likely to be enrolled in school than girls; the more educated the parents are, the more likely is the enrolment of a child in school; and mother's employment is an important determinant of enrolment.

### 4.4 Poverty

The government has been establishing measures such as the National Poverty Eradication Plan (NPEP) expected to be implemented over the period 1999–2015. The NPEP is tied to the new budgeting system, the Medium Term Expenditure Framework (MTEF). Three types of poverty are explicitly recognized in government documents (GoK 2002a, b), i.e., food poverty, absolute poverty and hard core poverty. Households whose food expenditure falls short of what is needed to purchase sufficient grain to supply FAO/WHO recommended intake of 2,250 calories per head per day are termed as food poor. The total expenditure of poor people is less than the minimum basic needs, which is estimated at KShs 1,239 in Kenya. The hard core poor cannot afford to pay for the minimum recommended calories even if they spend all their income on food. The proportion of overall poor persons in 1997 in Machakos and Makueni districts was estimated at 59% and 73.5%, respectively. By 2002, these proportions had risen to 82.7% (an increase of about 6%) and 62.9% (3.9% increase) in Makueni and Machakos districts respectively (Mwabu et al. 2002; Manda et al. 2001; GoK 2007a).

### 4.5 Transport and communication

Machakos District has three types of roads—bitumen (408.8 km); earth (709.4 km); and gravel (658.5 km). Over 1,400 households and 35 enterprises are connected to the mains electricity supply, while 1% of rural homes use solar power. At least 2010 households and 1,400 enterprises are connected to the land-line telephone service and there are 214 public telephone booths. Mobile telephone services are widely available throughout the district.

Makueni District is relatively well-endowed with transport and communications infrastructure. The road network comprises 254 km bitumen road, 551 km of roads paved with gravel, 760 km of earth roads and 4500 km of other road types. This road network supports transport between major population centers and the rest of the country by motor vehicle. Within the district, travel or transportation by local taxi (*matatu*) and other forms of vehicular transportation is common. Most parts of the district are accessible by lorry/pickup truck, bicycle and where the tsetse fly<sup>4</sup> menace is not pronounced, donkey or ox-cart. In addition, 225 km of railroad traverse the district and there are four airstrips. Only 950 households in Makueni District have their electricity supply connected to the national grid. All the 17 divisions had mobile telephone coverage by one or two service providers (Safaricom and Zain [Celtel]) but within each division, reliability of the network signal is variable. At least 16 of the trading centers had working landline telephone services.

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<sup>4</sup> Tsetse flies are carriers of *trypanosomes* which cause sickness and even death of oxen and donkeys (commonly used to transport goods, and even people) where infestation is high.

## 5. Crop production

About 85,000 ha and 4,000 ha were planted with maize and sorghum, respectively, in Machakos District (GoK 2005). In addition, there were 12,000 ha of beans, 4,000 ha of cowpeas 36,000 ha of pigeon peas, 1,500 ha of cassava, 2,000 ha of sweet potatoes and 3,500 ha of arrow roots. Corresponding acreages for Makueni District for 2006 were 46,955 ha (maize), 6,764 ha (sorghum), 19,130 ha (beans), 26,711 ha (cowpeas) and 21,199 ha of pigeon peas. At a mere 1,049 ha, cassava was a relatively minor subsistence crop. The range of crops identified at the FGDs is listed in Table 8. Typically, fields are intercropped (Figure 3). One field may have up to 10 different crops at any one time. Maize, however, was the main staple food crop, usually consumed in combination either with beans, cowpeas or pigeon peas, in varying proportions. Coffee and horticultural commodities were the major cash crops.

FGDs indicated that only small amounts of maize, beans, cowpeas and pigeon peas are sold when surpluses were obtained. FGD participants had difficulties in discussing their relative profitability, perhaps because the quantities involved were small and did not enter market transactions. Profitability and “risky crop” assessments are shown in Table 8.



**Figure 3. Some of the subsistence crops grown in Machakos and Makueni Districts.**

Although stockists would list as many as 20 improved varieties of crop (Bett et al. 2006), farmers at the FGDs mentioned only seven (six in Makueni district). As shown in Table 8, the pace of adoption of improved varieties has been slow. Dis-adoption rates (as declared at the FGDs) of established varieties such as DLC1 and KCB were high. Dis-adoption rates for local varieties were low though distinct.

Adoption rates for improved varieties ranged between 6% for H513 and 51% for Pioneer in Machakos District; and, between 2% for DK8031 and 7% for Pioneer in Makueni District. The reasons for low rates of adoption were that the varieties had only been introduced recently, and were being evaluated, and that seed price was very high. Another reason was that some of the new varieties have not addressed the main concerns of farmers such as risks. FGDs identified production risk as affecting maize, beans, and pigeon peas. Farmers who grew maize and other varieties would face price and marketing risk.

**Table 8. Major crops grown in Machakos and Makueni Districts.**

Crop	Variety	Adoption %	Disadoption %	Profitability 1= min; 5= max	Main risk	Riskiness 1= lowest; 5= highest
<i>Machakos</i>						
Maize	H513	6				1
Maize	Pannar	7				2
Maize	DH	13			Disease	1
Maize	DLC	23	70		Marketing	1
Maize	Duma	28		2	Management	3
Maize	CG4141	40			Price	
Maize	Local	50	50	3		1
Maize	Pioneer	51	36	1		4
Maize	Local (Kikamba)	90				1
Pigeon peas	Pigeon peas			2		
Beans	Beans			1	Production	
Cassava	Cassava			4	Price	
Coffee	Coffee				Price	1
Cowpeas	Cowpeas			3	Price	
<i>Makueni</i>						
Maize	DK8031	2	1		Price	1
Maize	DH	3			Production	
Maize	Duma	3	1		Marketing	2
Maize	KCB	4	55		Price	
Maize	Pannar	4	26		Marketing	1
Maize	Pioneer	7		5	Other	2
Maize	Local (Kinyanya)	80	10		Price	1
Maize	Local	96	5		Price	3
Beans	Beans	100			Production	1
Cassava	Cassava	90			Price	1
Cow peas	Cow peas	100			Price	
Pigeon peas	Pigeon peas	100			Production	1
Sweet potato	Sweet potato	5			Price	

Source: Community survey (2007).

## 6. Maize production

Farm households in the two districts consume a significant proportion of Kenya's maize crop, and attempt to produce enough to meet their own requirements and some surplus for sale each season with varying degrees of success. District level statistics show that mean acreage 1997–2005 was 147,000 ha for Machakos and 81,200 ha for Makueni. Over the same period, mean yields were 488 kg/ha for Machakos and 405 kg/ha for Makueni. These low average yields reflect near crop failure seasons (long rains [LR] 1998; LR 1999; LR 2000; LR 2004 and short rains [SR] 2005) when yields ranged from 0–75 kg/ha.

Figure 4 illustrates the types of maize crops grown in the area during July/August 2007. The top left picture shows a drought stressed crop near Wote, the Makueni district center. The top right picture shows a more typical maize field sown to a local variety. In this instance, neither spacing nor fertilizer recommendations were followed. The District Agricultural Officers (DAO) in the two districts estimated that about 55–65% of the farmers follow this practice, and that grain yield obtainable on such fields would be about 300–700 kg/ha, depending on the season. The picture on the bottom left of Figure 4 illustrates a local variety crop that was planted with no attention to spacing, weeding and fertilizer recommendations during a season with good rainfall and no pest or disease outbreak. Only about 100–200 kg/ha is expected from such crop management, estimated to be practiced by 5–10% of the farmers in the two districts. The picture on the bottom right shows performance of a crop sown to Duma 41 hybrid, in a good season, with most of the agronomic recommendations followed. The DAOs estimated that grain yields of up to 4 tons/ha plus another 4 tons/ha of stover for animal feed will be harvested.

The FGDs regarding the varieties grown, production constraints yield and price attributes for maize are presented in Table 9. Six varieties were identified for Machakos and eight for Makueni. Duma and Pannar varieties were comparatively new, while the Dryland (DH) and Pioneer hybrids have been grown in the area for more than five years. However, as Bett et al. (2006) have shown, over 20 maize varieties were kept by seed stockists in Machakos and Makueni. Duma series and PHB 3253 were ranked as the fastest selling varieties by the stockists. It was found that PHB 3253 was the most common maize variety grown in both Machakos and Makueni districts.



Figure 4. Maize production: constraints and opportunities in the Dry Transition Zone.

Table 9. Maize varieties, yields, prices and major constraints.

Maize variety	Type 1= Local; 2 = Improved	Constraint	Yield (kg/ha)	
			Min	Max
<b>Machakos</b>				
DLC	2	Low soil fertility, weeds (striga)	90	360
Duma	2	Low soil fertility, weeds (striga)	900	1,440
Kikamba	1	Weeds (striga)	90	270
Local	1	Diseases, drought, low soil fertility	90	270
Pannar	2	Weeds (striga)	90	450
Pioneer	2	Diseases, drought, soil fertility, striga	1,080	1,125
<b>Makueni</b>				
DH1	2	Various	270	540
DK8031	2	Drought	1,620	2,250
Duma	2	Drought, low soil fertility, weeds (striga)	760	1,260
KCB	2	Drought, weeds (striga)	180	405
Kinyanya	1	Low soil fertility, diseases, drought, weeds (striga)	1,200	2,250
Local	1	Drought	468	726
Pannar	2	Drought	1,200	2,250
Pioneer	2	Diseases, drought, weeds (striga)	870	1,280

Source: Community survey (2007).

The average yields of local varieties calculated from all FGD averages ranged from 590 to 980 kg/ha, and 851–1,202 kg/ha for improved maize varieties. Maize prices reported in government statistics ranged between KShs 5 and 10 per kg.

## 7. Risks and shocks in agriculture within the community

Subjective assessment of the frequency of occurrence of drought in the two areas at “one out of eight seasons” was largely consistent with published sources, e.g., GoK (2001); Downing et al. (1989) and Barrow and Mogaka (2007). The 1972–2006 period saw at least 10 incidences of drought, with varying in severity and consequences in Kenya. Incidences of plant pest and disease attack were reported to occur at a frequency of once in four years. Strategies to cope with the effects of drought included men migrating in search of employment especially in the construction, farm labor, and hotels industries. Women partake in informal trading e.g., selling vegetables and second-hand clothes. All the shocks identified were considered to affect maize production.

**Table 10. Risks, shocks and trends.**

Specific shocks	Frequency on average	Trend in last 10 years	Coping strategy against shock (year/years)
1. Drought	1 in 8	Increased	- Informal employment - Informal trade
2. Too much rains/floods	1 in 10	Decreased	None
3. Plant pests and diseases	1 in 4	Increased	Used agricultural chemicals
4. Livestock diseases	Seasonal	Increased	None. Waits for government help.
5. Destruction of crops by animals			
6. Dangerous weeds	1 in 10	Decreased	Feed the weed to livestock.
7. Large increase in input prices	10 in 10	Increased	- Use local seed. - Use animal manure.
8. Large drop in cereal prices	Always during good harvest	Increased	None.
9. Theft of property (of assets)	Whenever there is drought	Increased	- Employs watchman. - Plant less of the crop stolen

Source: *Community survey (2007)*.

### 7.1 Additional information on maize and crop production changes

More than 80% of the focus groups said the business of farming has become more difficult and risky over the past 10 years. Figure 5 illustrates the use of maize in the local livestock industry. The photo to the left shows livestock grazing in a maize field in which the farmer has lost all hope of getting substantial grain due to drought in July 2007. Maize stover is often harvested and carefully stored for either normal dry season feeding or during feed shortages caused by drought as illustrated in the picture on the left (Figure 5). They cited reasons such as inaccessible extension services,<sup>5</sup> high cost of inputs (such as seed and fertilizer), financial constraints, unaffordable transport to the market, reduced rainfall, reduced farm size, and invasion by pests. Those who said farming has become less difficult cited reasons such as being able to access a wide range of varieties and inputs.

<sup>5</sup> Although extension services were becoming available, farmers complained of the facilitation fee demanded by the extension agents whenever they are invited to offer extension advice. This is in line with the finding by Bett et al. (2006).



**Figure 5. Use of maize residue for animal feeding.**

Growing maize has also become more difficult, as mentioned by majority of the FGDs. Reasons given were inaccessible credit, lack of output market, unpredictable climate, reduced farm size, financial constraints, and occupation of the farm by other crops. Those who said growing maize has become less difficult/risky cited the availability of many modern seed varieties in the market and easy access to output market. However, many farmers in the FGDs expressed their dismay with emergence of fake seed in the market; a finding reported by Bett et al. (2006). This has impacted negatively on the adoption trend of improved varieties in the area.

## **7.2 Gender aspects in farming (crop production)**

Men and women are users and managers of resources but with different roles, responsibilities and opportunities in accessing and making better use of those resources at the household and community levels (Rocheleau et al. 1995). Gender is central to positioning both men and women vis-à-vis institutions that determine access to land and other resources. Women control the purchase of particular crops or seeds such as bananas, cassava, pigeon peas, beans, maize, millet, vegetable seeds (particularly cabbages), tomato seeds, cow peas, sweet potatoes, fruits, pumpkin, and arrow roots. However, maize was cited as a crop for both men and women. Except for beans, vegetables and fruits, women control the income of all other crops without having to consult with their spouses. In addition, they control income from sorghum and Irish potatoes. However, women have special responsibility for all crops (Table 11). It was gathered from FGDs that some men undertake off-farm employment and participate in social activities, leaving little time for crop management.

**Table 11. Crops whose production, sales and income is controlled by women.**

<b>Crops or seeds whose purchase is controlled by women</b>	<b>Crops whose income is controlled by women</b>
Bananas	Bananas
Cassava	Cassava
Pigeon peas	Pigeon peas
Beans	Sorghum
Maize	Maize
Finger millet	Finger millet
Vegetable seeds (cabbages)	Irish potatoes
Tomato seeds	Tomato seeds
Cow peas	Cow peas
Sweet potatoes	Sweet potatoes
Fruits	Pumpkin
Pumpkin	Arrow roots
Arrow roots	

*Source: Community survey (2007).*

### 7.3 Price of maize inputs and outputs, and the changes

The FGDs revealed that the price of maize grain ranged between KShs 8.1–12.3/kg in Machakos and 7.3–13.9/kg in Makeni. The price range for green maize was KShs 5–10/cob, while that for residue was higher at KShs 60–120/bundle. The weight or volume of the bundle was not specified. These are prices for the 2006/7 seasons. Nominal price changes between 1997 and 2007 ranged from KShs 5–15/kg (grain); from KShs 5–10 per cob (green) and from KShs 20–120 per bundle (residue).

The stockists' retailing price for a 2-kg packet has been rising annually as shown by the price trends: KShs 249 in 2002; KShs 354 in 2003; KShs 356 in 2004; KShs 359 in 2005; and KShs 363 in 2006. However, the stockists' buying price (from distributors) did not follow any clear trend: KShs 329 in 2002; KShs 331 in 2003; KShs 323 in 2004; KShs 328 in 2005; and KShs 325 in 2006. The buying and selling prices of Duma hybrid varieties also did not follow any clear trend. For instance, the 2-kg packet of Duma 41 retailed at KShs 330 in 2002 but reduced to KShs 325 in 2003 and KShs 296 in 2004. It rose again to KShs 326 in 2005 and KShs 318 in 2006. The stockists' buying price of Duma 41 was KShs 293 in 2002, then rose and fell so that by 2006, it was KShs 280. Ariga et al. (2006) note that despite the rising world prices of fertilizers, farm-gate prices in Kenya have remained almost constant over the past 10 years.

## 8. Credit and in-kind assistance

Although there were a number of financial institutions in both districts, only about half of the FGDs reported easy access to credit. Those who found it difficult mentioned various constraints such as lack of collateral (some did not have title deeds, especially in Makeni). In addition, they mentioned production and market risks, lack of awareness and information, reduced extension service, and lack of cash crops to help them repay the loan. In Machakos, there were five banks, 34 SACCOs and four micro-finance institutions. In Makeni, there were three micro-finance institutions, one bank and one other type of financial institution (Kenya Women Finance Trust) as reported in the respective District Development Plans for 2002–2008 (GoK 2001).

According to the FGDs, there were 80–200 mutual support groups in the area. These are run by members supporting each other through cash donations and in-kind contribution. In-kind contribution typically includes labor, meeting expenses for social events such as funerals, weddings, education and purchase of household goods. Among the mutual support groups, some operated like micro finance institutions and CBOs. While most micro finance institutions did not have farming activity as their focus, some supported informal trade. In 2006, for instance, 75% of the households in some villages received credit from the micro finance institutions. The interest rate charged was on average 20% per month. Kenya Rural Enterprise Program Bank (K-REP) was one of the main lending institutions in the area whose activities were deeply rooted in the community. In comparison with other institutions, its interest rate was as low as 3% per month. Specifically, K-REP Bank through its Farmers Savings Association (FSA) outlets provided credit in-kind and cash. The requirement for K-REP credit was that beneficiaries must be members of a group. The credit provided was meant for a wide range of activities such as business, education, household goods and purchase of livestock, in addition to paying bride wealth.

## 9. Local organizations and institutions

Among the major types of organizations in the study area, women groups are the most frequent. According to the FGDs, 20–75% of the households had at least one member belonging to one or more of these organizations. The core purpose of such organizations was the provision of mutual assistance on a revolving basis. This arrangement works in such ways that members support each other, with every member receiving the benefit(s) in turn, on a rotational basis. The assistance they provide to each other varies from group to group but the resources pooled could provide capital for an informal business. Women groups were found to be very helpful in the community. Some of the direct benefits included helping members buy household goods or pay for their children's education. Although slowly emerging, youth groups had not yet become as established in the study area as women groups had. However, as shown in Table 12, women constituted a small percentage of the members. According to members of the community, youth groups were seen as very helpful as they kept the members busy, in addition to providing them with income generation avenues such as tree nurseries and brick-making. Male-female groups (where membership and participation is not based on gender) were a new dimension in formation of social organizations. However, it appeared that women constituted the minority (30%) in these organizations. Men-women groups were considered to be very helpful as members provided labor exchange among themselves (Table 12).

**Table 12. Local organizations and institutions.**

Category	% of households belonging to organization	% of women (average)	Main purpose	Why useful
1. Women group	20-75	100	- Merry-go-round - Business - Collateral for members	- Helps members buy goods and pay for their children education.
2. Youth group	15	5	- Tree nurseries. - Income generating (e.g. brick-making).	- Keeps youth busy. - Youth earn income.
3. Men-women group	35-50	30	- Labor exchange	Support each other (e.g. farming, terrace making, etc.).

*Source: Community survey (2007).*

## 10. Livelihood sources and strategies

Agriculture contributes about 75% of income while rural and urban self employment accounts for 15% and 8%, respectively. Crop production was the main livelihood sustaining activity in which 95% of people were involved (Table 13), including men, women and children. Other activities are construction (70%), employment in government (55%), petty trade (46%) and livestock production (30%). As indicated, petty trade was mainly done by women. Other minor activities were collection of natural products, sale of firewood and casual labor. Firewood is sold predominantly by women.

**Table 13. Community and household level livelihood strategies.**

Livelihood source	% of people involved (average)			Who is most commonly involved
	Mean	Min	Max	
Crop production	95	90	100	Men, women and children
Livestock production	30	10	50	Men and women
Collection of grown and natural products	20	?	?	Men
Government salary (services, teaching, etc.)	55	10	100	Men and women
Day labor (construction activities)	70	?	?	Men
Petty trade	46	15	78	Women
Selling of firewood, etc.	15	?	?	Women
Casual labor	8	?	?	Men and women

Source: *Community survey (2007)*.

## 11. Food security

All the FGDs indicated that communities or households in the study area considered themselves to be in a state of food shortage whenever rains failed or were inadequate, and when this situation led to low crop production or total failure. Shortage of staple food crops in the local grain markets was also considered an indication of famine. Some FGDs stated that whenever there was non-adoption of modern agricultural technologies, it was an indicator of food shortage. Households that suffered from hard core poverty experienced food shortages whenever there were no food donations from the government and donors. FGDs assessed the prevalence of food-insecure households in Machakos and Makueni at 67%. Members of the community devised coping strategies for times of food shortage by working off-farm, selling livestock (small animals and cattle) and receiving food donations from the government and well-wishers.

Mainly due to unreliable rainfall, households in Machakos and Makueni districts experience frequent food shortages leading to perpetual reliance on food donations from the government and other donors. In 2004/5, Machakos experienced a severe food shortage, necessitating distribution of relief food on a massive scale. In four months alone (August, October, November and December), 1,620 and 1,550 tons of maize and beans, respectively, were distributed by the government in the affected divisions of Kalama, Yathui, Katangi, Masinga, Ndithini, Central and Kathinai (GoK 2005). The district had 6,996 and 1,028 tons of maize and beans, respectively, in reserve (Kangundo District Agricultural Extension Officer [DAEO 2005]). In Kaiti Division, the food situation was different from that of the other parts of the district as food was readily available in the market centers. However, due to the low purchasing power of some farm families in locations such as Kyuasini, Utaani, Iuani and Kivani, there was a food shortage (Kaiti DAEO 2005).

## 12. Environmental conditions

In both Makueni and Machakos districts, FGDs identified changes in the state of natural resources and in the environment over the past 20 years. Most of the changes experienced have been negative such as reduced rainfall, drought, soil erosion, dwindling water sources, and bare land. These negative changes were mainly attributed to destruction of vegetation through cutting down of trees for wood and charcoal-making. Another reason for destruction of vegetative cover was to facilitate new human settlements, farming and grazing of livestock. The few positive changes experienced in some areas have been attributed to improved vegetation cover through planting exotic trees, mainly sourced from South Africa. This has led to the revamping of the water sources resulting in some streams flowing with water. Sinking of boreholes has also improved the water situation in some areas. Lack of adequately safe water is a global problem, with more than 1 billion people lacking access to safe water. KNHDR (2006) indicates that a large proportion of people in Machakos (62.1%) and Makueni (58%) do not have access to safe drinking water. These are higher percentages than the national average (42.3%) and that of Eastern Province (55.7%). Despite the fact that Kangundo and Kaiti divisions lie on hilly land, most members of the community depended on temporary wells sunk in dry river beds to access water.

### 13. Main productive resources held in common by the community

Machakos District has a long history of settlement mainly on account of more favorable growing conditions for crops and livestock. Makueni District, on the other hand, was settled relatively recently. The communities in the two districts have a common ethnicity and shared local institutions for managing access and use of common resources such as water and forests (Table 14). In both districts, the community forest and water resources were the two common resources whose availability seemed to be decreasing over time. The forest has only been spared total destruction through government legislation, as it is government-owned. However, community water resources are controlled by informal regulations set by members of the community themselves. All members of the community have only limited access to the forest simply for fear that they might destroy it.

**Table 14. Common user resources.**

Communal productive resources	Rules or institutions that govern access	Changes in availability and importance	Type of competition in the use
1. Community grazing land	N/A	N/A	N/A
2. Community forest	- Public forest, thus governed by government legislation.  - Groups regulate use of water and maintenance of water sources.	Decreasing	- Payment (done on first-come basis)
3. Community water resources	- Villagers to share water equitably. - Avoid contaminating water	Decreasing	- Competition in use of scarce water resources. - Queue to get water.

Source: *Community survey (2007)*.

Due to scarcity of water, as shown in Figure 6, wells are often sunk, as shown in the second picture, and members of the community have to compete for resources. In order to access water, one often has to queue at the water points.



**Figure 6. Household access to water for domestic and agricultural use.**

## 14. Conclusions

The community survey described here has facilitated the analysis of the socio-economic and biophysical environment in which new DTMA varieties will be adopted. The study also provided the context for the design, conduct, analysis and interpretation of household surveys conducted subsequently in 2008. The study integrated community level information with production and price data and information to characterize household livelihoods, cropping systems, farm production and inputs markets, and it generated insights into the constraints faced by farmers as well as opportunities available to them. These objectives were pursued through 12 focal group discussions and key informant sessions in Kangundo (Machakos) and Kaiti (Makueni) in Kenya, during June–July 2007.

The findings of the community survey portrayed two communities faced with shrinking landholding sizes and degradation of the natural resource base through loss of nutrients and erosion of soil, biodiversity and grazing resources. Through FGDs, the communities in the two districts voiced their awareness of the challenges they face. These challenges included declining amounts of seasonal rainfall, increased frequencies of drought and increased risk of crop failure. While FGDs identified improvements in the road transport infrastructure as facilitating improvement in the reach and densities of farm inputs distribution, the majority of smallholders have not benefited due to high access costs. Assessment by most of the FGDs was that farm productivity in general, and maize productivity, in particular, were declining. This decline in maize productivity was attributed to factors such as continued reliance on low yielding and risk-prone varieties, lack of extension services and unavailability of credit. The general assessment was that more than two-thirds of the households were food insecure most of the year. Health status was considered to have deteriorated over the preceding 10-year period, despite the marked improvement in the number and quality of service providers now available in the area. The level of poverty (already higher than the national average) was considered to be increasing.

The findings of this survey indicate that if DTMA varieties with higher yields, better drought tolerance and shorter maturity periods than the varieties currently in the market were available, adoption would likely occur. The survey identified a fairly dense network of farm input suppliers who would help facilitate seed distribution. Seed distribution is also likely to benefit from the network of NGOs (8 in Machakos and 11 in Makueni) and CBOs whose typical activity portfolios include aspects of agricultural development. Given the high levels of poverty in the two areas, however, widespread adoption of DTMA varieties is unlikely to occur in the absence of policies which address incentives to farm inputs traders on the one hand, and, on the other hand, farmers cash constraints as well as aversion to the risk of losing their investment in the maize crops, in case of drought. The study identified a number of financial institutions and also the cooperative movement in the two areas. At the time of the survey, lending for agricultural purposes was a low priority for these institutions. FGDs assessed maize production as a farm activity for which both men and women share responsibility for resource allocation as well as benefits. Widespread adoption of DTMA varieties is likely to result in greater empowerment of women.

While bearing in mind the strengths of the FGD and key informant interview methods employed for this study, in interpreting the findings and conclusions proposed by the authors, the approach displays limitations. Carefully designed adoption studies to facilitate statistical or econometric modeling of cause-effect relationships among household characteristics, variety attributes, institutional factors, drought risk and the likelihood of adoption are needed to complement the findings of this survey. The results of this type of survey can aid in establishing objectives for maize variety development, evaluating or adapting experiments and, not least, designing strategies to make the varieties available to majority of farmers.

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## Appendix Table

**Table A1. Drought incidences in Kenya 1896–2006**

<i>Period</i>	<i>Region most affected</i>	<i>Remarks</i>
1896–1900	Kikuyu Kamba lands, Coast, much of East Africa	Failed three seasons, 25–75% of population lost
1907–1911	Lake Victoria, Machakos, Kitui, coast	Food scarcities
1913–1919	Ethiopia, Kamba lands, Coast	Coincided with Sahel
1915	Malakwe famine	
1929	Nzalikye famine	
1942	Upesi famine	
1943	Mbulunga famine	
1945	Mwolio famine	
1952–1955	Kitui and other districts	Exports reduced drastically
1960–1961	Masai lands, Machakos, Kitui, Rift Valley, Northern Districts	Drought followed by floods
1968	Atta famine	
1972	All dryland area	Livestock mortality and water shortage
1973–1976	Kajiado, Kitui, Lower Meru, Machakos, Tana River, Turkana	Government project for food
1973–74	Most parts of Kenya	Human and livestock deaths in Northern Kenya
1974–76	Eastern, Central and Northern Provinces	Some pastoralists lost about 80% of livestock
1980	Central, Eastern, Western and Coast Provinces	Crop failure, livestock deaths, water shortage
1980	Yua ya nukwangete famine	
1981	Eastern Province	Livestock deaths and crop failure
1981	Eastern Province	Large imports famine with cash in pocket
1983	Coastal hinterland, Kitui, Machakos, Meru, Kakamega, Nyanza	Poor long and short rains. High grain prices.
1983	Countrywide	Livestock deaths
1984	Central, Rift Valley, Eastern and North Eastern	Large imports
1984	Central, Rift Valley, Eastern and North Eastern	Large food deficit and livestock deaths
1987	Eastern and Central	Severe food shortage in Eastern Province
1992–1994	Northern, Central and Eastern Provinces	Severe food shortage and livestock deaths
1999–2000	Countrywide except Western and Coast	High livestock mortality
2006	Most parts of the country	Dryland areas hit most, high livestock mortality
1952	Floods	
1997–1998	El Nino rains	
1931	Locusts destroy crops	
1985	Army worm invasion	
1919	Epidemic contagious bovine pleuropneumonia (CBPP)	

Source: Barrow and Mogaka (2007); Downing et al. (1989).

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